ART 34 AMDT

CLAIMS

1. A light emitting diode (LED), comprising an electrode adapted for electron injection, a second opposing electrode adapted for hole injection, one or more intermediate semi-conductor layers arranged therebetween and optionally one or more further layers wherein the LED comprises at least one substantially periodic microstructured feature adapted to manipulate emission and/or propagation of light by coupling non-radiative waveguide-modes to far-field radiation.

2. A LED as claimed in claim 1 wherein the substantially periodic microstructured feature is configured to increase efficiency of emission by facilitating the coupling, at least in part to useful far-field radiation so recovering some of the energy that would otherwise have been lost to non-radiative waveguide-modes.

3. A LED as claimed in Claim 1 or Claim 2 wherein the microstructured feature is adapted to modify the intensity, polarisation or spectrum of emitted light.

4. A LED as claimed in any preceding claim wherein the microstructured feature is generally lateral, such as to extend in a substantially parallel plane to the one or more semi-conductor layers and/or further layers of the device.

5. A LED as claimed in any preceding claim wherein the microstructured feature is specifically configured to control the polarisation state of emitted radiation.

6. A LED as claimed in any preceding claim wherein the microstructured feature is adapted to control the frequency of radiation emitted in a given direction.

7. A LED as claimed in Claim 6 wherein the periodic microstructure consists of many regions of different periodicity to couple out light of different colours.

8. A LED any preceding claim wherein the microstructured feature is configured in conjunction with the photonic band-structure of the LED to allow for the preferential excitation of one or more desired wave guide modes.

9. A LED any preceding claim wherein the microstructured feature is of microscopic scale in the order of 50 – 2000 nanometers, more preferably between 100 and 600 nm, more preferably between 350 and 450 nm and ideally 400nm.

10. A LED as claimed in any preceding claim wherein at least one semi-conducting layer, or a component thereof, is capable of light emission by luminescence.

11. A LED as claimed in any preceding claim wherein the microstructured feature is solid such that any or all microstructured layers are continuous.

12. A LED as claimed in any preceding claim wherein the microstructured feature provides the entirety of at least one of the microstructured layers and/or electrodes.

13. A LED as claimed in any preceding claim wherein the microstructured feature acts as a diffraction grating.

14. A LED as claimed in any preceding claim wherein the microstructured feature comprises features in the form of corrugation, which is in the form of one or more non-planar surfaces or layers and comprises an array of opposed projecting portions.

15. A LED as claimed in Claim 14 wherein the depth between peaks and troughs is of the order five to hundreds of nanometers.

16. A LED as claimed in Claim 15 wherein the depth is between 10 and 200 nm, more preferably between 20 and 120 nm.

17. A LED as claimed in any of Claims 14 to 16 wherein the corrugation is in the entirety of the layer.

18. A LED as claimed in any preceding claim wherein the microstructured feature comprises areas of modified refractive index.

19. A LED as claimed in Claim 18 wherein the portions of the layer with modified refractive index are present within the layer and are in the form of lines or areas of modified refractive index laterally across the layer.

20. A LED as claimed in any preceding claim comprising at least one organic or organometallic semi-conducting layer.

21. A LED as claimed in Claim 20 wherein the organic semi-conducting layer comprises a conjugated polymeric material.

22. A LED as claimed in any preceding claim comprising at least one inorganic semi-conducting layer.

23. The use of a semi-conducting organic or organometallic layer with lateral microstructure in a LED as claimed in any preceding claim.

24. The use of a LED as claimed in any of Claims 1 to 22 as a light emitting display of any desired surface area and for portable or fixed purpose.

25. A method for the production of a light emitting diode, wherein a laminar structure is fabricated comprising an electrode adapted for electron injection, a second opposing electrode adapted for hole injection, one or more intermediate semi-conductor layers placed therebetween, and optionally one or more further layers, and further comprising the step of adapting the LED such that there is at least one substantially periodic microstructured feature adapted to manipulate emission and/or propagation of light by coupling non-radiative waveguide-modes to far-field radiation.

26. The method of Claim 25 wherein the adapting step comprises incorporating at least one semi-conducting organic layer with lateral periodic microstructure of suitable period to facilitate the coupling, at least in part to useful far-field radiation so recovering some of the energy that would otherwise have been lost to non-radiative waveguide-modes.

27. The method of Claim 26 wherein the semi-conducting organic layer is coated in a layer by means of spin coating, dip-coating, printing, evaporation or epitaxial growth.

28. The method of any of Claims 25 to 27 wherein the microstructured feature is produced by embossing, photolithography, microcontact printing or laser holography or by deposition on a microstructured substrate or microstructured contact.

29. The method of Claim 28 wherein microstructured features are created by exposing a photoresist or other further layer to at least one laser beam.

30. The method of Claim 29 wherein the microstructure is then transferred from the photoresist layer to the substrate upon which it is supported, typically the transparent support to the LED structure.

31. A LED adapted for light emission substantially as hereinbefore described with reference to the accompanying drawings.

32. A method for the production of a LED adapted for light emissions substantially as hereinbefore described with reference to the accompanying drawings.